SYNCHROTRON BASED INFRARED TECHNIQUE TO STUDY OXIDE FILMS ON METALS

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The advantages of synchrotrons as a unique source of infrared radiation, in the mid and far spectral region have been clearly demonstrated [1,2]. In this presentation, we describe techniques involved in studying surface species using infrared microscopy.

Tantalum oxide films have been the subject of study in many areas [3-5] including corrosion, integrated circuits and capacitors. Infrared reflectance spectroscopy measurements include the use of multiple external reflections on anodic oxides films of Ta grown in acid solutions [6]. In our work, we employed synchrotron based infrared micro-spectroscopy to monitor and characterize anodic oxide films grown on valve metals (e.g., Al, Ta, and Zr) in near-neutral solutions. Fig.1 and Fig. 2 show the infrared reflectance measurements on anodic oxide films grown on Al and Ta respectively in neutral borate solutions (pH 8.4) at a current density of $10 mA/cm^2$ until the desired voltage was reached. Aluminum oxide has a strong Al-O bond vibration at 950 cm^{-1} while the vibration of the Ta-O bond exhibits a broad peak at 925 cm^{-1}. Shifts in the Ta-O vibration at higher potentials have been observed. The shifts could be due to a change in the structure of the oxide film. The characteristics of the oxide films on these valve metals including the type of oxides and the metal-to-oxygen bond vibrations will be discussed in relation to their growth kinetics, thickness and solution composition.

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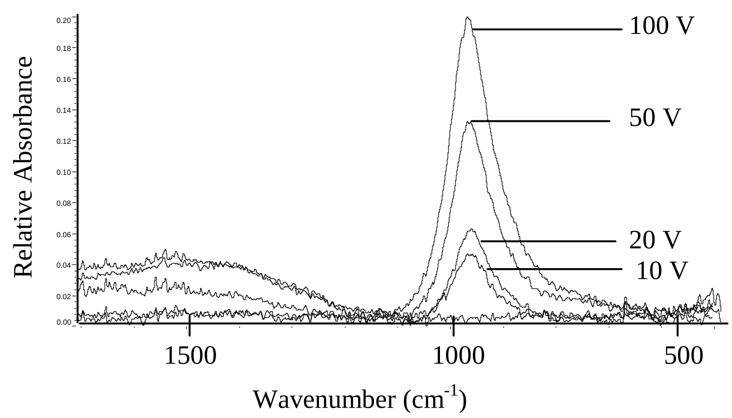

Fig 1. Grazing angle IR spectra of Aluminum oxide grown to different thickness

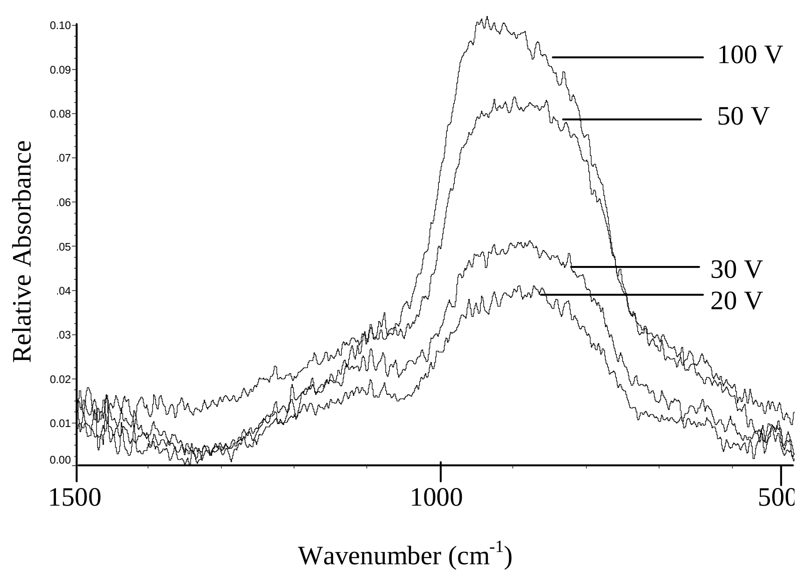

Fig 2. Grazing angle IR spectra of Tantalum oxide grown to different thickness